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(71) Applicant

The Marconi Company Limited (United Kingdom),  
The Grove, Warren Lane, Stanmore, Middlesex HA7 4LY

(72) Inventors

Gillian Denise Kellet,  
Peter Geoffrey Russell Kitson,  
James Auterson

(74) Agent and/or Address for Service

Roger K. Toifree,  
The General Electric Company plc, Central Patent Dept  
(Chelmsford Office), Marconi Research Centre, West  
Hanningfield Road, Gt Baddow, Chelmsford, Essex

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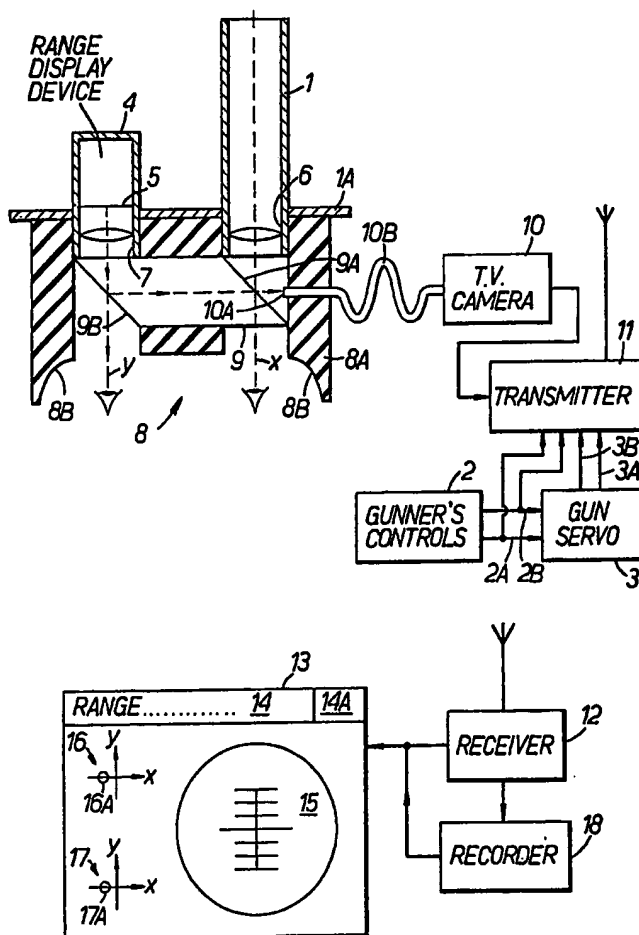
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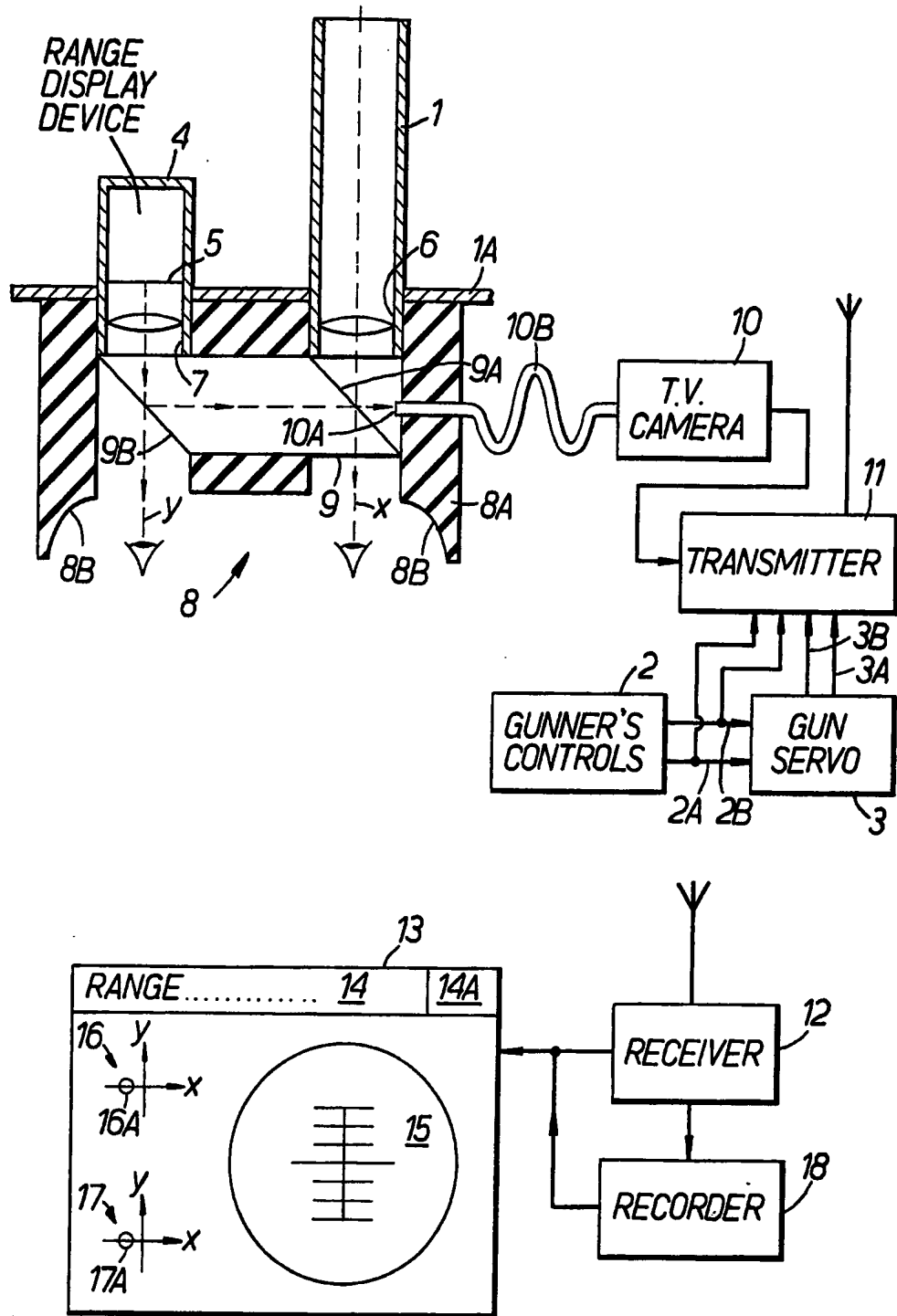
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## (54) Apparatus for training a gunner

(57) Apparatus for training a gunner comprises a viewing device 8 which fits over the eyepieces of a gun sight 1 and of a device 4 for displaying range information from a rangefinder. The viewing device has a prismatic image combiner 9 which combines the images from both eyepieces to be viewed by a video camera 10 linked to the viewing device 8 via a flexible optical fibre coupling 10B. The gunner is able to view both eyepieces as normal through the image combiner 9. The image viewed by the camera 10 together with pictorial information representing the operation of the gunner's controls and the movement of the gun is transmitted by a transmitter 11 to a receiver 12 at a remote location where an instructor is able to view on a display 13 precisely the same scene as viewed by the gunner together with the additional information indicating how he is operating the gun controls and how the gun is moving. A recorder 18 is provided to enable playback and analysis of the training exercise.





## SPECIFICATION

### Apparatus for training a gunner

5 This invention relates to apparatus for training a gunner. It was developed particularly for training gunners in fighting vehicles such as tanks but it is applicable to other types of gun, even hand-held guns.

10 A problem in the training of gunners is that the instructor cannot see the same view, through the gun sight, as the trainee and it is therefore necessary to expend live ammunition before the instructor can establish whether the trainee's aim is correct. The need to use live ammunition is of course very expensive. It also limits the type of training exercise which can be performed since live ammunition cannot of course be used in exercises where one gunner is required to fire at another. The aforementioned difficulties become particularly acute when the training exercise requires the trainee to aim a gun mounted on a moving tank or other vehicle and the invention arose with a view to reducing these difficulties.

25 This invention provides apparatus for training a gunner comprising: a viewing device by which the gunner may view a target through a gun sight; and a video camera linked to the viewing device by a flexible optical coupling enabling it also to view the target through the gun sight.

The output of the video camera is preferably transmitted, via an antenna, either to an instructor (who may be a range commander) at a remote location and/or to an instructor positioned on or in the vehicle. In the latter case the instructor would need to carry a lightweight portable monitor. The camera output may also be recorded for subsequent playback in order to analyse the response of the trainee. Because the camera is linked to the viewing device by a flexible coupling the camera can be conveniently located at any desired position, even in a tank where space is limited.

The viewing device preferably includes some means for deflecting a proportion of the light from the gun sight to the flexible optical coupling whilst allowing the remainder to pass to the gunner's eye. This may be done using a partially reflective mirror or, more preferably, using a prism constructed and arranged so that some of the light incident on it is reflected to the flexible coupling and some transmitted through the prism to the gunner's eye.

Some guns, e.g. in tanks, are equipped with two eyepieces: one for the gun sight and the other for a display device arranged to display information to the gunner concerning for example the range of the target as measured by a rangefinder aligned with a gun and gun sight. For such guns the apparatus of the invention may advantageously include an image combining arrangement for deflecting some of the light from the gun sight and from the display device towards the flexible coupling so that the TV camera views a combined image identical to that seen by the gunner when looking through both eyepieces with respective eyes. The image combining arrangement can be formed by an arrangement of partially

silvered mirrors but it is preferably a prismatic image combiner.

The viewing device is preferably designed to fit over an eyepiece of the sight and, where provided, over an eyepiece of the display device. In this way, no modification to existing equipment associated with the gun or tank is required and the viewing device can easily be removed when not required. The viewing device is preferably also designed to act as a face-piece shaped to conform with the shape of the gunner's head.

The invention is particularly applicable in circumstances where an instructor is simultaneously instructing a number of gunners, e.g. in tanks on a training exercise. Each tank is equipped with a viewing device, optical coupling, TV camera, transmitter and antenna and is adapted to transmit on its own channel so that the instructor can tune in to a selected gunner to monitor his performance.

75 In some gun arrangements, e.g. in a tank, when the gunner is attempting to track a target he manipulates a control device to produce elevation and azimuth demand signals respectively representing the desired angular velocity of the gun in elevation and azimuth. It has been found useful to provide the instructor with an indication of the rate of change of the gunner's demand i.e. the rate of change of each of the elevation and azimuth demand signals, and this can be done by modifying each frame of the transmitted signal so as to devote part of it to the production of a visual indication of the rate of change of the gunner's elevation and azimuth demand signals. These values are of significance since, as a general rule, the rate of change of demand will be zero when a skilful gunner is tracking a target and will oscillate through zero for a less skilful gunner. A similar visual indication of the rate of change of the gun's position is preferably also provided in the transmitted signal so that discrepancies between rate of change of demand and rate of change of gun's position can be noted, such discrepancies being indicative of a malfunction in the gun's survey system.

One way in which the invention may be performed will now be described by way of example with reference to the accompanying drawing of a training apparatus constructed in accordance with the invention.

Referring to the drawing a tank comprises a sight 1 carried by a mounting 1A which is fixed relative to a gun (not shown). A gunner views a target through the sight 1 whilst manipulating controls 2 to produce x and y demand signals on lines 2A and 2B respectively. The x demand signal denotes the desired rate of change of azimuth of the gun and the y demand signal denotes the desired rate of change of elevation of the gun. The signals on lines 2A and 2B control a gun servo 3. This operates by driving the whole turret including the gunner and the gun in azimuth and by driving the gun and the sight 1 and mounting 1A in elevation relative to the gun turret. The gun servo 3 also produces signals on lines 3A and 3B denoting the actual rate of change of azimuth and elevation. These values should be the same as the values on lines 2A and 2B but there may be

discrepancies if the gun servo 3 is not operating correctly.

In certain cases, as in the illustrated case, a range display device 4 forms an integral part of the gun sight 1. This is controlled by a laser rangefinder aligned with the gun and gun sight to produce a signal representing the range of the closest object at which the gun is pointing. This is displayed in digital form on a screen 5.

The sight 1 and display device 4 have eyepieces 6 and 7 respectively spaced apart so that the gunner can look through them simultaneously with respective eyes. The viewing device 8 has a rubber or synthetic rubber casing 8A which is sufficiently flexible and resilient to enable it to make a frictional push fit over the eyepieces. It can also be readily removed when not required. The front surface of the casing 8A is shaped at 8B to fit comfortably against the gunner's face. The viewing device contains a prismatic beam combiner 9 made from a single piece of glass and having parallel faces 9A and 9B intersected by optical axes x and y of the sight 1 and display device 4 respectively. The majority of light from the sight 1 and display device 4 passes through the faces 9A and 9B to be seen by the gunner through respective eyes. About 25% of light incident on faces 9A and 9B (the actual proportion being controlled by suitable part-silvering of the faces 9A and 9B) is reflected towards the end 10A of the flexible fibre optic coupling 10B. The end 10A of the flexible coupling is mounted in the housing 8A whilst the other end is connected to a video camera 10. The camera is mounted in some suitable position in the gun turret of the tank and can readily be fitted and removed as necessary. The coupling 10B need to be flexible to allow movement in elevation of the gun and sight 1 relative to the rest of the turret and to allow for location of the camera at any convenient position in the confined space in the turret.

A transmitter 11, also mounted within the turret, receives video signals from the camera and is designed to devote part of each frame to the pictorial representation of the signals received on lines 2A, 2B, 3A and 3B.

During a stationary training exercise the performance of the gunner may be monitored by an instructor using a lightweight portable monitor whilst a range commander is in control of a receiver 12 at a fixed or mobile base station. The portable monitor is not shown. During "firing on the move" exercise the performance of the gunner is monitored by an instructor in control of a receiver 12. The receiver 12 can be tuned to receive signals selectively from any one of a number of transmitters like that shown at 11 located in different tanks.

The receiver 12 has a display indicated at 13 on which is displayed the same image as in seen by the gunner and consisting of range information at 14 and the view through the sight 15. On the display 13, there also appears a pictorial representation at 16 of the signals on lines 2A and 2B and a pictorial representation at 17 of the signals on lines 3A and 3B. The x and y co-ordinates of a spot shown at 16A represent the rate of change of the gunner's demand in azimuth and elevation and the x and y co-

ordinates of a spot shown at 17A represents the rate of change of the angular position of the gun in azimuth and elevation respectively. In addition a video number generator allows a unique number to be dialled onto the display at 14A. This number is selected by the instructor for ease in selecting playback sequences.

The output of the receiver 12 is also recorded by a video recorder 18 having facilities for slow playback through the display device 13 to allow analysis of the training exercise after it has been completed. This facility is considered to be of considerable value in enabling trainee gunners to recognise any mistakes which they may have made.

Various modifications to the illustrated system are of course possible. For example the prismatic beam combiner illustrated could be replaced by two half silvered mirrors at the same positions as the faces 9A and 9B of the illustrated prism. Another possible modification would be to adapt the housing 8A to be mounted on a gunner's face rather than on the eyepiece of the gun sight. In any of these forms, the invention can be used whilst the tank is stationary or moving and it is believed that it will prove to be of outstanding benefit during training exercises using either blank or live ammunition.

#### CLAIMS

1. Apparatus for training a gunner comprising: a viewing device by which the gunner may view a target through a gun sight; and a video camera linked to the viewing device by a flexible optical coupling enabling it also to view the target through the gun sight.
2. Apparatus according to claim 1 including a transmitter for transmitting signals from the camera to a receiver.
3. Apparatus according to claim 1 or 2 in which the viewing device includes an optical member through which information in light form from the gun sight passes to the gunner's eye, this optical member being constructed and arranged to deflect a proportion of the light to the flexible optical coupling.
4. Apparatus according to claim 1, 2 or 3 in which the viewing device is adapted to allow the gunner to view the target through the gun sight with one eye and to view a display system for displaying information about the viewed target with the other eye; and in which the flexible optical coupling enables the camera to view both the target through the gun sight and the information displayed on the display system.
5. Apparatus according to claim 4 in which the viewing device comprises two partially reflective and partially transmissive surfaces arranged to reflect a proportion of light from the display system and from the gun sight towards the flexible optical coupling whilst allowing the remaining light to pass through the viewing device thereby enabling the gun sight and the display system to be viewed normally by the gunner.
6. Apparatus according to any preceding claim mounted in a vehicle equipped with a gun.

7. Apparatus according to any preceding claim in which the viewing device is releasably mounted over an eyepiece of the gun sight.

8. Apparatus according to any one of claims 1 to 5 6 adapted to be mounted to the face of the gunner.

9. Apparatus according to any preceding claim in which the viewing device includes a glass prismatic beam combiner.

10. A training system comprising two or more apparatuses according to any preceding claim each adapted to transmit on a different channel; and a receiver having means by which the instructor may switch between channels.

11. A training system substantially as described 15 with reference to the accompanying drawing.